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NASA Procedural Requirements

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Responsible Office: Facilities Engineering and Real Property Division

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CHAPTER 1. NASA's Maintenance Program

1.1 NASA Maintenance Philosophy

NASA's maintenance philosophy is to aggressively and proactively pursue and adopt the safest, most cost-effective, best blend of Reliability Centered Maintenance (RCM) techniques, safety procedures and other best practices to provide safe and reliable facilities to support NASA's mission.

1.2 NASA Maintenance Objectives

NPD 8831.1, Management of Facilities Maintenance, states that policy for managing facilities maintenance, in support of the stated policy NASA is the following:

1.2.1. Provide maintenance and repair of facilities and collateral equipment that protects the health and safety of personnel, protects the environment, protects and preserves NASA's capabilities and capital investment, and enables mission performance by following good business practices while minimizing life-cycle facilities costs.

1.2.2. Manage and perform facilities maintenance work cost effectively and efficiently by using state-of-the-art maintenance management systems and RCM techniques. Management systems shall, as a minimum, include a standardized and meaningful annual work plan, accurate facility condition assessment techniques, and NASA-owned (NASA or contractor maintained) Computerized Maintenance Management System (CMMS) databases.

1.2.3. Use accepted standards as a guideline to assist in determining facilities maintenance funding requirements, such as the National Research Council's (NRC) recommended 2- to 4-percent of the facilities replacement value for its facilities and equipment maintenance and repair program.

1.2.4. Continuously and proactively improve technical and managerial processes to minimize life-cycle maintenance and repair costs. These include Centers designating a single point of contact to communicate and coordinate facilities maintenance and management issues with NASA Headquarters for maximum efficiency and effectiveness; benchmarking and the identification of "best practices"; preparing and adhering to annual- and 5-year maintenance plans; performing self-assessments and applying reengineering or process-improvement techniques where appropriate; applying NASA-streamlined RCM principles, as detailed in the NASA RCM Guide for Facilities and Equipment Maintenance, in program development and improvement; implementing Predictive Testing and Inspection (PT&I) techniques, where appropriate and whenever possible; and maximizing the population of available CMMS databases to allow for competitive, fixed and fixed-unit cost pricing.

1.2.5. Provide for the lowest life-cycle costs, improve the safety, and establish initial baselines for the subsequent PT&I of facilities and equipment through the acceptance process by enforcing the construction contractor's quality control responsibilities during construction and particularly at the time of equipment acceptance.

1.2.6. Properly account for facilities' maintenance and repair expenses in accordance with the NASA Financial

Management Manual - Agencywide Coding Structure - FMM Volume 9100.

1.2.7. Use performance-based contracts with clearly defined scopes to capitalize on the contractor's experience and ingenuity; to contract for results and not just best efforts; to maximize best value through the use of Fixed Pricing and Unit Cost pricing with competition; and to improve quality through contractor selection based on past performance, by measuring against prescribed, objective and measurable performance standards, and by following a formal Quality Assurance Plan.

1.3 Center Participation

1.3.1. Video-Conferences. NASA Center maintenance management personnel should participate in the monthly Facility Maintenance Video-Conferences. These conferences provide an opportunity to educate personnel in new tools available for use, to disseminate lessons learned Agencywide, and to facilitate the adoption of improved practices.

1.3.2. Facility Maintenance Conferences and Workshops. NASA Center civil service and support contractor maintenance management personnel should attend facility maintenance conferences and workshops. These conferences and workshops are an opportunity to exchange ideas, make contacts with other Centers' maintenance personnel, and learn new maintenance practices that can be utilized in Center programs.

1.3.3. Center Point of Contact. Each Center and Component Facility will establish a single point of contact for interfacing with the NASA Headquarters, Facilities Engineering Division's Maintenance Team concerning facilities maintenance matters.

1.4 Pillars of the Maintenance Program

1.4.1. Safety. Per NPD 8700.1, NASA Policy for Safety and Mission Success, it is NASA policy to "Avoid loss of life, personal injury or illness, property loss or damage, or environmental harm from any of its activities and ensure safe and healthful conditions for persons working at or visiting NASA facilities." Safety is the Agency's number one core value. Accordingly, in the operations and maintenance of a Center's facilities, the maintenance organization shall make every effort to assure that this NASA policy for safety is adhered to in all of its activities and that the procedural requirements contained in NPR 8715.3, NASA Safety Manual, are incorporated into their daily activities.

1.4.2. Maintenance Funding and Reporting. See chapter 2 of this NPR for more detailed information. As the steward of its facilities, NASA is responsible for reporting to higher authority (Office of Management and Budget (OMB) and Congress) on ways its facilities maintenance funds are spent. To make this possible, Centers shall use Functional Management System (FMS) codes to account for and report to Headquarters their facilities maintenance funding. Additionally, for accuracy and credibility, it is necessary for Centers to establish methods in their CMMS to capture all costs associated with facilities maintenance work. NASA has adopted the National Research Council's recommendation that 2- to 4-percent of the Current Replacement Value (CRV) should be targeted for only facilities maintenance and minor repair.

1.4.3. Maintenance Management Program. See chapter 3 of this NPR for more detailed information. Maintenance management consists of all aspects of defining the requirements, job planning, job execution and analysis. An effective facilities maintenance management program maximizes the useful life of the facilities and equipment, minimizes unplanned downtime, provides an improved work environment, and produces information to make Management decisions, all within a given resource level. The approach is customer oriented and mission focused. The challenge for NASA, both at Headquarters and throughout the Agency, is for continuous improvement within the available resources, as measured and monitored by meaningful and reliable Headquarters and Center performance metrics and trend analysis, and capitalizing on the very best and latest information available through benchmarking and the adoption of best practices.

1.4.4. Annual Work Plan. See chapter 4 of this NPR for more detailed information. The annual work plan provides Centers with a vehicle to display long and short range facility requirements by articulating their needs based on mission impact and the most probable facility availability outcomes under varying budget scenarios. The plan must be designed so that it can be integrated smoothly into NASA's strategic management process, afford Center Facilities Maintenance Managers and other senior managers the ability to make risk-based decisions regardless of the budget environment, and also allow Center facility maintenance organizations to pursue and measure their continuous improvement efforts. Centers should also maintain 5-year Facilities Maintenance Plans for resource planning beyond the Annual Work Plans.

1.4.5. Maintenance Execution. See chapter 5 of this NPR for more detailed information. Maintenance execution consists of work generation, work reception and tracking, work order preparation and work execution. The maintenance execution phase should be developed based on the guidance of this NPR, best practices and available resources and should be customized to most satisfactorily address the needs of each Center.

1.4.6. Computerized Maintenance Management System (CMMS). See chapter 6 of this NPR for more detailed information. Facilities maintenance managers at NASA Centers are to use modern maintenance management systems and methods to control work activities, account for resources, and to monitor and report work execution

through the use of various industry standard metrics and other management indicators. All CMMS databases must remain the property of NASA, regardless of who, NASA and/or the contractor, populates and maintains them, and any applicable maintenance contracts must explicitly include language to that effect.

1.4.7. Reliability Centered Maintenance (RCM). See chapter 7 of this NPR for more detailed information. It is NASA's policy to apply RCM principles in program development and improvement. Implementing this policy emphasizes the use of RCM concepts and its supporting programs to ultimately reduce life-cycle costs of facilities and systems of varying criticality and failure impact on NASA missions. RCM is to be used as early as possible in the planning and design stages to set technical tolerances, performance criteria and PT&I standards. RCM concepts are to be used by planners, designers, equipment procurement specialists, construction managers, and Operations and Maintenance (O&M) civil service and contractor personnel and/or anyone else involved in NASA facilities planning, design, construction, equipment procurement, and maintenance and operations.

1.4.8. Reliability Centered Building and Equipment Acceptance. See chapter 8 of this NPR for more detailed information. The NASA Reliability Centered Building and Equipment Acceptance Guide focuses on reducing facility life-cycle costs (especially infant mortality costs) by integrating PT&I techniques into the construction contractor's quality control program for equipment acceptance. In today's tight budget environment for facilities operations and maintenance, it is advantageous to use the construction contractor's quality control function to perform noninvasive diagnostic tests to verify equipment condition and installation prior to the contractor's exit from the job site. The Reliability Centered Building and Equipment Acceptance Guide focuses on using PT&I technologies to test and accept new systems during equipment installation, repair or rework, and the contractor making installation modifications as necessary to meet the prescribed standards. The result is an initial database of equipment condition for the subsequent maintenance program, the avoidance of premature wear caused by latent manufacturing defects or faulty installation, better information upon which RCM decisions will be based, longer equipment life, and ultimately minimal overall facility operating costs.

1.4.9. Backlog of Maintenance and Repair (BMAR). See chapter 9 of this NPR for more detailed information. BMAR (Also known as Deferred Maintenance) has recently taken on new, higher interest in the Federal Government, particularly in the OMB and Congress. With this interest, NASA's Deferred Maintenance (DM) shall be used in benchmarking with other agencies. With increased funding cutbacks and the need to manage funding availability more efficiently, there is a renewed requirement in ensuring that NASA's DM is realistic and that any ensuing funding is spent wisely. If the DM is to be a useful tool for assessing facility condition and determining and supporting the budget requirements to bring it to a manageable level, Agencywide use of a uniform, cost-effective procedure for determining and documenting DM is required. Such a standardized procedure for calculating DM still under development and will be forthcoming.

1.4.10. Facility Condition Assessment (FCA). See chapter 10 of this NPR for more detailed information. FCA's provide NASA Centers with information to properly develop 5-year and annual work plans and priorities for facilities maintenance, repair and revitalization. Headquarters needs adequate FCA information to ensure the proper stewardship over facilities entrusted to NASA, as well as to assist Agency Senior Management and higher authorities in projecting facilities budgetary needs in conjunction with NASA meeting its mission as directed by the President and Congress. Despite their importance, formal FCA's are time-consuming and costly to perform. Maximum use of RCM procedures and PT&I techniques that monitor facility and equipment condition, and continuous inspection that incorporates historical information from the CMMS database, ongoing maintenance and repair efforts and customer and user feedback, is necessary to provide Centers with valuable FCA information that in the past had to be developed manually. This continuous inspection coupled with minimal facility condition inspections provides the FCA without the formal process.

1.4.11. Central Utility Plant Operations and Maintenance. See chapter 11 of this NPR for more detailed information. Central Utility Plant O&M is included here because of its close operational and organizational association with facilities maintenance management. The management of utility system inspection and maintenance is directed toward maintaining safety, minimizing system downtime, minimizing cost and minimizing waste. To provide safety, reliability, high quality, and economical utility services, Utilities Management must ensure that equipment and distribution systems are maintained in top working order and that distribution line losses are identified and corrected. Standard Operating Procedures (SOP) must be developed to cover routine operations, startup and shutdown, operator maintenance, preventive maintenance, and other emerging actions such as load shedding.

1.4.12. Performance-based Contracting (PBC). See chapter 12 of this NPR for more detailed information. NASA is committed to implementing the use of PBC to the maximum extent possible. Under the PBC concept, the Government contracts for specific services and outcomes, not resources. Contractor flexibility is increased, Government oversight is decreased and attention is devoted to managing performance and results and ultimate outcomes. Contractor-Government partnering is highly recommended to achieve mutually supportive goals. The PBC should encourage the use of contractor best practices and cutting edge maintenance practices used in the private sector to give NASA the best product.

1.5 Facilities Maintenance Definition

1.5.1. In order to implement the policies in NPD 8831.1, Management of Facilities Maintenance, and the guidance in

this document, it is necessary to fix commonality of all facilities maintenance definitions Agencywide among NASA Centers and the Centers' Component Facilities. This permits the application of uniform measures of facilities condition; allows meaningful, quantitative metrics in terms common throughout the Agency and the ability to statistically analyze variances; enables compiling an information database using terminology and definitions common to and recognized by commercial software products and other industrial and Government applications; and adds credibility to the NASA facilities maintenance budgeting process through standardization. In addition to the definitions listed in Appendix A, Centers must use the definitions, and specifically the nine facilities maintenance work elements defined in the paragraphs below to identify, classify, and analyze facilities maintenance trends, to prepare the Center's Annual Work Plan and 5-year Plan, and for all other Agencywide facilities maintenance applications:

1.5.1.1. Facility. A term used to encompass land, buildings, other structures and other real property improvements, including utility systems and collateral equipment. The term does not include operating materials, supplies, special tooling, special test equipment, and noncapitalized equipment. (See Financial Management Manual (FMM) 9255-3 for capitalization criteria for capitalized equipment.) The term "facility" is used in connection with land, buildings (facilities having the basic function to enclose usable space), structures (facilities having the basic function of a research or operational activity), and other real property improvements.

1.5.1.2. Equipment. In NASA, equipment is broken down into two categories, collateral equipment and noncollateral equipment. These are defined as follows:

a. Collateral Equipment. Encompasses building-type equipment, built-in equipment, and large, substantially affixed equipment/property, and is normally acquired and installed as part of a facility project.

(1) Building-Type Equipment. A term used in connection with facility projects to describe equipment, which is normally required to make a facility useful and operable. It is built in or affixed to the facility in such a manner that removal would impair the usefulness, safety, or environment of the facility. Such equipment includes elevators; heating, ventilating, and air conditioning systems; transformers; compressors; and other like items generally accepted as being an inherent part of a building or structure and essential to its utility. Such equipment also includes general building systems and subsystems such as electrical, plumbing, pneumatic, fire protection, and control and monitoring systems.

(2) Built-in or Large, Substantially Affixed Equipment. A term used in connection with facility projects of any type other than building-type equipment that is to be built in, affixed to, or installed in real property in such a manner that the installation cost, including special foundations or unique utilities service, or the facility restoration work required after its removal, is substantial.

b. Noncollateral Equipment. Includes all equipment other than collateral equipment. Such equipment, when acquired and used in a facility or a test apparatus, can be severed and removed after erection or installation without substantial loss of value or damage thereto or to the premises where installed. Noncollateral equipment imparts to the facility or test apparatus its particular character at the time (e.g., furniture in an office building, laboratory equipment in a laboratory, test equipment in a test stand, machine tools in a shop facility, computers in a computer facility) and is not required to make the facility useful or operable as a structure or building.

1.5.1.3. Facilities Maintenance

a. The recurring day-to-day work required to preserve facilities (buildings, structures, grounds, utility systems, and collateral equipment) in such a condition that they may be used for their designated purpose over an intended service life. It includes the cost of labor, materials, and parts. Maintenance minimizes or corrects wear and tear and thereby forestalls major repairs. Facilities maintenance includes Preventative Maintenance (PM), PT&I, Grounds Care, Programmed Maintenance, repair, Trouble Calls (TC) (facilities repair), Replacement of Obsolete Items, and Service Request (Not a maintenance item but is work performed by maintenance organizations). Facilities Maintenance does not include fire protection, security and custodial services, new work, or work on noncollateral equipment.

b. The elements of facilities maintenance and their Center-level dollar limitations are as defined in the following paragraphs. Centers should be prepared to report their planned and actual facilities maintenance effort by these nine elements when requested by NASA Headquarters.

(1) Preventive Maintenance. The planned, scheduled periodic inspection (including safety), adjustment, cleaning, lubrication, parts replacement, and minor repair (no larger than TC scope) of equipment and systems for which a specific operator is not assigned. PM consists of many checkpoint activities on items that, if disabled, would interfere with an essential Center operation, endanger life or property, or involve high cost or long lead time for replacement. PM is the cornerstone of any good maintenance program. A weak or nonexistent PM program could result in safety and/or health risks to employees, much more emergency work, and costly repairs. Center-level dollar limitation is any dollar amount.

(2) Predictive Testing & Inspection. Those testing and inspection activities for facility items that generally require more sophisticated means to identify maintenance requirements than in PM. For example, specialized tests are

used to locate thinning of pipe walls and fractures (e.g., eddy current testing, radiographic inspections, ultrasonic testing, television cameras, or aural leak detectors); to detect roof weaknesses or wet insulation areas (e.g., infrared thermographic viewers or nuclear density devices); to identify large equipment wear problems (e.g., vibration analyzers and oil analysis for wear metals and lubricant properties); and to locate charge or heat buildup in electric equipment (e.g., infrared thermography). Center-level dollar limitation is any dollar amount.

(3) Grounds Care. Grounds Care is the maintenance of all grassy areas, shrubs, trees, sprinklers, rights-of-way and open fields, drainage ditches, swamps and water holding areas (lakes, ponds, lagoons, canals), fences, walls, grates, and other similar improvements to land that are included in the NASA Real Property Accountability System, and exterior pest and weed control. The maintenance tasks include mowing, spreading fertilizer, trimming hedges and shrubs, clearing ditches, snow removal, and related work. Included in this category is the cost of maintaining Grounds Care equipment such as mowers and tractors. Center-level dollar limitation is any dollar amount.

(4) Programmed Maintenance (PGM). Programmed Maintenance consists of those maintenance tasks whose cycle exceeds 1 year, such as painting a building every 5th year. (This category is different from PM in that if a planned cycle is missed the original planned work still remains to be accomplished, whereas in PM only the next planned cycle is accomplished instead of doing the work twice such as two lubrications, two adjustments, or two inspections.) Examples of PGM include painting, roof maintenance (flood coat, flashing, patching, incidental repair by replacement), road and parking lot maintenance (overlays, seal coating, and patching), utility system maintenance (piggging of constricted lines), and similar functions. Center-level dollar limitation is any dollar amount.

(5) Repair. That facility work required to restore a facility or component thereof, including collateral equipment, to a condition substantially equivalent to its originally intended and designed capacity, efficiency or capability. It includes the substantially equivalent replacements of utility systems and collateral equipment necessitated by incipient or actual breakdown. Center-level dollar limitation is any dollar amount not to exceed \$500,000.

(6) Trouble Calls (TC). TC's (subset of repair) are generally called in by telephone or submitted electronically by occupants of a facility (or facility managers or maintenance workers). Where the calls are for nonfacility work (not of a facility maintenance or repair nature) the call must be coded so that it is not included with TC's included in funding level calculations. Examples of nonfacility work are interior pest control and janitorial work such as cleaning up a spill or cleaning carpets. TC's are composed of two types of work as follows:

(i) Routine Calls. Routine calls are minor facility problems that are too small to be estimated (usually less than about 20 workhours or \$2,000) and are generally responded to by grouping according to craft and location. Center-level dollar limitation is any dollar amount not to exceed \$500,000.

(ii) Emergency calls. Emergency calls require immediate action to eliminate hazards to personnel or equipment, to prevent loss of or damage to Center property, or to restore essential services that have been disrupted. Emergency work is usually a response-type work effort, often initially worked by TC technicians. Due to its nature, emergency work is not restricted to a level of effort such as Routine Calls (although in many cases it falls within the workhour and/or dollar limit of routine calls). Center-level dollar limitation is any dollar amount not to exceed \$500,000.

(7) Replacement of Obsolete Items (ROI). There are many components of a facility that should be programmed for replacement because they are becoming obsolete (no longer parts-supportable at the end of service life), do not meet electrical or building codes, or are unsafe but are still operational and would not be construed as "broken" and needing repair. Center-level dollar limitation is any dollar amount not to exceed \$500,000. Examples include but are not limited to the following:

(i) Electric switchgear, breakers, and motor starters.

(ii) Elevators.

(iii) Control systems.

(iv) Boiler and central Heating, Ventilating, and Air Conditioning (HVAC) systems and controls.

(v) Fire detection systems.

(vi) Cranes and hoists.

(vii) Air conditioning systems using Chlorofluorocarbon (CFC) refrigerants.

(8) Service Requests. Service Requests are not maintenance items, but are so often performed by facilities maintenance organizations they become a part of the baseline. Service Requests are requests for facilities related work which is new in nature, and as such, should be funded by the requesting organization. Service Requests are initiated by anybody on the Center, are usually submitted on a form, often require approval by someone before any action is taken, usually are planned and estimated, materials procured, and shop personnel discretely scheduled to accomplish the work. Examples of these requests include installation of an outlet to support a new copier machine; providing a compressed air outlet to a new test bench; renovating an office; and installing special cabinetry. Center-level dollar limitation is any dollar amount not to exceed \$500,000.

(9) Central Utility Plant Operations and Maintenance. This category is unique in that it includes the cost of operations in addition to maintenance costs. It should be used only to capture the costs of operating and maintaining institutional central utility plants, such as a central heating or steam plant, wastewater treatment plant, or central A/C (chiller) plant. The concept is that operators are assigned full time to operate the plant, but they perform maintenance between various operating tasks, making it almost impossible to segregate operational and maintenance costs. Therefore, the costs of the full-time operators (and their materials) are shown here. This facilities maintenance element does not include any work outside of the 5-foot line of the utility plant or "project" type work. Center-level dollar limitation is any dollar amount.

1.5.1.4. Backlog of Maintenance and Repair (BMAR). The BMAR also known as "Deferred Maintenance" is the unfunded facilities maintenance work required to bring facilities and collateral equipment to a condition that meets acceptable facilities maintenance standards. The key word is "unfunded." If resources are or will be available to do the work during the current year, the work is considered to be scheduled and is not part of the backlog.

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